International Journal of Architecture and Urban Development
Vol. 14, No. 4, P .Autumn 2024

E-ISSN 2345-2331
Applied Research Article
DOI: 10.71711/ijaud.2024.1192406

Expounding the Prefabricated Infill Model in Housing Development within Historical Urban Fabrics (Case Study: Yazd's Historical Fabric)

[1]Tayebeh Heydari, [2] Ahmad Mirzakouchak Khoshnevis, [3]Haleh Hoseinpour, [4]Hadiseh Kamran Kasmaei*

[1]*Ph.D. Candidate of Architecture, Department of Architecture, Pardis Branch Azad University, Pardis, Iran.*
[2*]*Assistant Professor, Department of Architecture and Urbanism, Research Institute of Cultural Heritage and Tourism, Tehran, Iran.*
[3]*Assistant Professor, Urban Development Department, Pardis Branch, Islamic Azad University, Pardis, Iran.*
[4]*Assistant professor, Pardis Branch, Islamic Azad University, Pardis, Iran.*

Recieved 03.12.2024; Accepted 22.06.2025

ABSTRACT: The historical urban fabrics of Iran are increasingly threatened by contemporary construction practices that often neglect the principles of Iranian-Islamic architecture. As a result, the cultural and spatial identity of these areas is gradually diminishing. This research investigates the principle of "compatibility" as a design strategy for integrating advanced construction technologies into historic contexts through infill housing. Focusing on the historic core of Yazd, which UNESCO recognizes for its unique desert architecture and the continuity of its cultural traditions, the study employs an applied, descriptive methodology. Based on the 2021 census, 10,795 households reside in the area. Using proportional stratified random sampling and Morgan's table, 384 household heads across nine districts were selected for survey distribution. Data collected through questionnaires and interviews revealed multiple factors critical to compatible infill development, including transportation systems, street morphology, proportional harmony, visual coherence, building scale, spatial continuity, land use organization, construction speed, economic feasibility, aesthetic integration, and value preservation. Factor analysis grouped these into three principal dimensions: aesthetics (mean score of 3.49), cost (3.32), and speed (3.45). The findings emphasize the need for context-responsive design approaches that reconcile modern construction demands with the preservation of heritage values. By offering empirical insights and a structured framework for assessing compatibility in historic environments, this study contributes to the discourse on sustainable urban regeneration. It provides architects, planners, and policymakers with criteria to guide infill housing strategies that maintain architectural integrity while addressing contemporary urban needs.
The findings demonstrate the potential of machine learning to support human-centered design by enabling the early-stage evaluation of housing for the elderly. The proposed predictive framework can inform architecture curricula, computer-aided design (CAD) tools, and age-friendly housing policies.

Keywords: *Compatibility, Infill Architecture, Low-Cost Architecture, Historical Urban Fabric.*

INTRODUCTION

Today, historical contexts and old city centers endure numerous deficiencies, and due to unnecessary and unprofessional interventions, the process of renovation and development within these contexts has worsened over time. It must be acknowledged that the lack of attention to public participation and feedback regarding how to construct has become one of the contemporary issues and challenges in these areas. This need broadens the topic of renovating dilapidated urban contexts in the country (Abouie & Jafari, 2015).

The use of new materials, constructions, and renovations that are not in harmony with the historical fabric not only fails to align with its historical context but also disrupts the integrity and physical identity of the historical fabric. New constructions should not lead to the destruction of old buildings; therefore, to preserve and continue the historical context while also creating new buildings, it is essential to draw inspiration from the style, form, volume, color, facade, proportions, usage, placement, scale, details, and materials of surrounding buildings (Ghadiri, 2006; Shahteymouri & Mazaheriyan,

*Corresponding Author Email: *a.khoshnevis@richt.ir* *ORCID:0000-0002-9555-7893.*

2012). This approach aims to maximize the connection and continuity between new constructions and the adjacent fabric with minimal visual damage (Ghareh Beyglou et al., 2019).

Infill buildings and new constructions within historical contexts must embody the spirit of the time and express it while also considering the historical context in which they are situated (Ghadiri, 2006). This is why various approaches and perspectives in infill architecture have emerged concerning the design and integration of new elements alongside historical structures (Masoud & Beygzadeh Shahraki, 2014). The diversity of advanced systems for cost-effective construction and the speed of execution have resulted in a reduction in design variety and the presentation of architectural traditions (Parham & Halimi, 2021).

This research focuses on a combined method that can, on the one hand, be cost-effective and fast, and on the other hand, be suitable for Iranian identity. In new constructions within Iranian historical contexts, two prevalent approaches have so far been renovation and restoration, which generally aim to reduce construction costs and expedite the process.

At the same time, efforts have been made to consider the quality of construction, particularly regarding structural resistance, especially in seismic contexts, which has inevitably led to a clash between the architectural facade of historical contexts and the appearance of buildings lacking Iranian identity and culture. Housing, as a consumable commodity, accounts for the largest share of household expenditure. Additionally, housing can serve as a capital good, attracting a significant portion of the community's capital and liquidity, which in turn leads to increased speculative demand in the housing market.

The various construction methods used for foundations, walls, roofs, and structural elements have faced challenges regarding the stability and durability of the structures, as well as the safety and psychological satisfaction of residents in historical contexts, while also reducing costs. It has been determined that approximately 26.11% to 22.68% of construction costs can be saved by using advanced housing construction technologies compared to traditional methods (Zabetiyan, 2016).

Iran is one of the few countries with diverse climatic conditions, where indigenous architecture has evolved through the adaptation of architecture to its natural environment, resulting in a wide variety of climatic architectural styles. The discussions surrounding climatic architecture encompass a wide range of issues, from the shape and volume of buildings to the material composition and color. The people of Iran, particularly those residing in arid and hot climates, have developed effective methods over the years to cope with extreme heat.

Analyzing the influential factors on architecture reveals that the architectural structure in this climate is one of the determining factors in shaping architecture. The impact of climate is evident in every single building and the elements of the architectural spaces, as well as in the entire urban fabric and lifestyle. This issue has led architects, from ancient times to the present, to pay attention to the relationship between architectural contexts and the different climates in which they are situated.

Architectural construction in hot and dry climates has always been associated with local earthen materials and, necessarily, vaulted and domed structures. This architecture has achieved a modular structural order through the use of modular construction methods, as this system has been utilized in architectural designs across the hot and dry climate from Semnan to Qom, Isfahan, and from Kerman to Yazd and Shiraz,

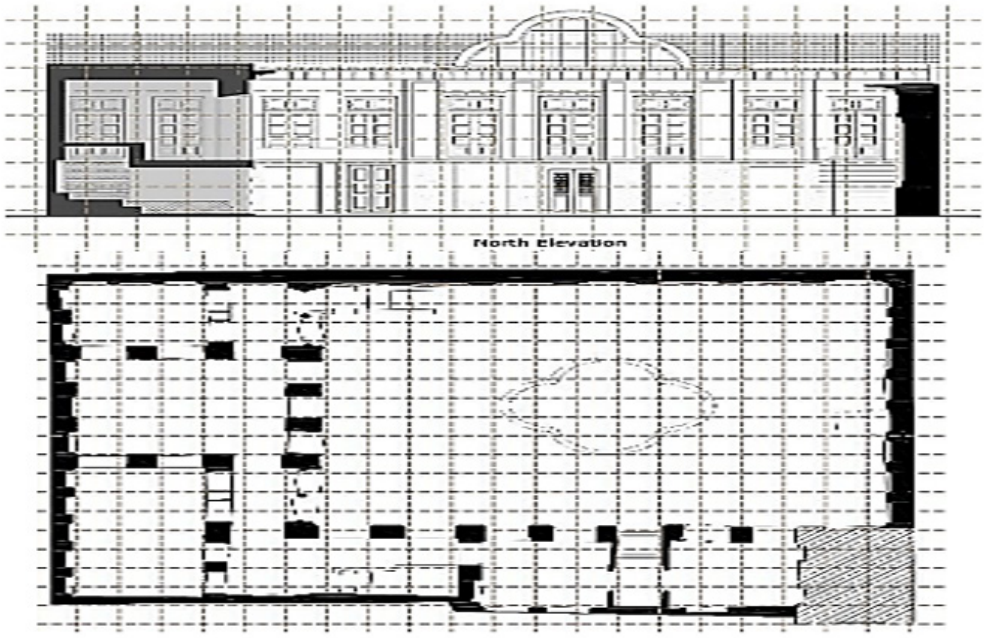


Fig. 1: Design pattern based on the modular grid in the Atroosh House, where each grid unit is one "gaz." (Source: Pesaran et al., 2019)

and this order is consistently seen in the plans, facades, and geometrical structure of the buildings.

Walls, arches, and domes serve as precast elements that are placed alongside each other to form the building's structural framework.

Literature Riview

The intersection of modern construction methods and historical urban fabrics has become a pivotal area of research, particularly as cities grapple with the challenges of preserving cultural heritage while accommodating contemporary needs. Many historical urban areas in Iran, characterized by their rich Iranian-Islamic architectural and urban heritage, are increasingly threatened by the encroachment of modern design practices that do not align with traditional aesthetics or values. This dynamic necessitates a comprehensive understanding of how new developments can be integrated into these historical contexts without compromising their integrity.

Incremental Development Strategies. Noriyan et al. (2018) emphasize the significance of incremental development strategies within urban planning, particularly in the context of District 6 of Mashhad. Their research advocates for the utilization of cross-sectional zoning as a means to facilitate sustainable growth in urban areas. The authors argue that such strategies not only preserve the historical character of neighborhoods but also enhance the adaptability of urban spaces to modern requirements. By prioritizing compatible development, urban planners can ensure that new constructions harmonize with existing structures, thereby fostering a sense of continuity and coherence within the urban fabric.

Integration of New Structures in Historical Contexts. Abouie & Jafari (2015) offers a critical perspective on the placement of infill buildings within historical sites, examining the implications of integrating new structures in light of international restoration guidelines. This analysis underscores the tension between innovation and tradition, illustrating the need for a balanced approach that respects historical narratives while addressing contemporary demands. Furthermore, Ghazanfariyan & Ziabakhsh. (2021) explore the architectural criteria essential for the qualitative design of cultural spaces, identifying specific factors that contribute to effective urban design solutions. Their findings reinforce the notion that thoughtful design strategies are crucial for creating environments that promote community interaction and cultural continuity.

Interdisciplinary Approaches to Mid-Block Architecture. The research conducted by Ghareh Beyglou et al. (2019) introduces an interdisciplinary framework for understanding mid-block architecture within historical contexts. Their study of the Constitutional Commercial Complex in Tabriz highlights the potential for contemporary designs to both respect and enhance traditional urban settings. This approach aligns with Razeghi and Hoorandi's (2018) examination of the theoretical underpinnings of mid-block and historical-cultural proximity, which advocates for designs that reflect the historical essence and philosophy of place. They argue that integrating historical awareness into architectural practices is crucial for achieving a balanced dialogue between past and present.

In a related study, Olovizadeh et al. (2018) investigate how the degree of divergence in mid-block buildings influences the continuity of life in the historical fabric of traditional Iranian markets. Their research emphasizes the importance of contextualism, suggesting that a deep understanding of the historical language and patterns inherent in these fabrics is essential for maintaining their vitality and coherence. Ghaderian (2017) further explores this notion by discussing the duality of development and preservation in mid-block projects, asserting that successful revitalization efforts must prioritize the interconnectedness of new developments with the historical context.

Identifying Gaps in the Literature. Despite the valuable insights provided by these studies, a notable gap remains in the literature regarding the application of advanced construction methods—specifically, the use of prefabricated infill models—in historical urban fabrics. While existing research has extensively addressed theoretical and practical considerations for preserving harmony in these areas, there has been limited exploration of how modern construction techniques can be effectively integrated into traditional settings. This oversight is critical, as it hinders the development of comprehensive design principles that take into account the nuances of both contemporary construction and historical preservation.

Research Aims. The present research aims to fill this gap by examining the principles of compatibility in prefabricated infill housing within the historical fabric of Yazd city. By focusing on key factors such as traffic systems, street networks, proportions, visual unity, construction scale, coherence of the historic fabric, and aesthetic values, this study aims to provide a nuanced understanding of how modern construction practices can be adapted to align with traditional architectural values. Through the analysis of data collected from the heads of households in Yazd's historic districts, this research will categorize influential factors into three primary categories: aesthetics, cost, and construction speed. By doing so, it aims to provide actionable design principles that promote sustainable urban development while preserving the rich architectural heritage of Iran.

Ultimately, this study aims to make a significant contribution to the ongoing discourse on urban revitalization and architectural compatibility, providing a framework that empowers planners and architects to create harmonious spaces that balance historical significance with modern functionality.

Theoretical Framework

Peymon has been a method for facilitating work and guiding all dimensions of construction. It allows an architect to utilize a single size and scale. This approach introduces diversity into architecture, which is why no traces of imitation are found in any of the buildings. In Iranian architecture, peymon, or construction scale, comes in three forms: small peymon, large peymon, and fractional peymon (Pirnia & Mahranian, 2019; Fig. 2).

Peymon influences not only the plans and dimensions of foundations and columns but also the width and length of rooms and corridors. It also determines the shapes of doors and windows, as well as the proportions between them. Furthermore, it impacts the coverings of doorways, porches, arches, and domes. This influence becomes

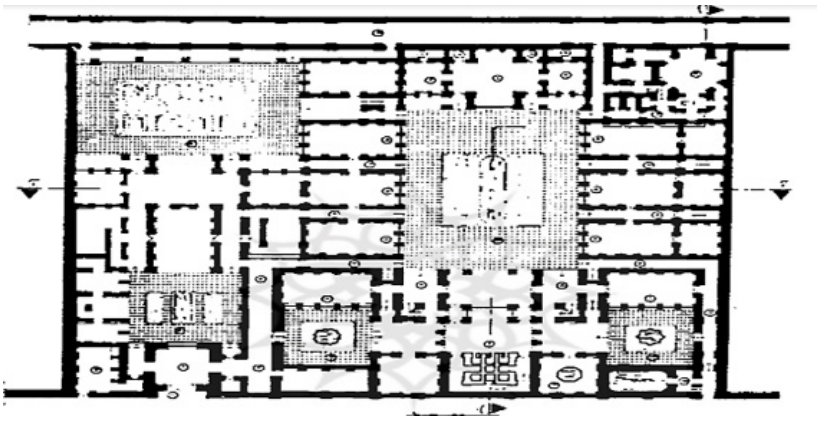


Fig. 2: Map of the Nawab Safavi House in Yazd (Source: Bamanyan, 2002)

evident when the Iranian architect can confidently apply peymon to simultaneously design, calculate, and execute the project without causing instability (Pirnia & & Mahranian, 2019). Table 1 shows case studies of three systems of peymon.

In case studies, traditional construction methods for housing demonstrate that the use of modern prefabricated housing technologies can effectively replace previous methods, being both cost-effective and economically advantageous for the construction industry. It is essential to leverage the benefits of modern, low-cost building materials that can help prevent rising expenses and pollution while also utilizing natural energy sources. This research emphasizes the use of biodegradable natural and local materials that have minimal environmental impact, as well as their recyclability and ease of maintenance, ensuring durability (Abouie & Jafari, 2015).

The construction system comprises design regulations and production systems that enable various components to be compatible and utilize different building parts suitable for assembly. In essence, a construction system refers to the creation of a framework for a building or a collection of construction components produced in various ways to create different building configurations (Sarja, 1998). This includes all activities necessary for a specific type of building construction, along with the techniques and methods of execution (Warszawski, 1999). Figure 3 illustrates the analysis of the Traditional Structure and Proposal for Implementing Advanced Construction Systems.

Table 1: Case Studies in the Three Systems of Peymon: Large, Small, and Fractional Peymon (Zakari et al., 2016)

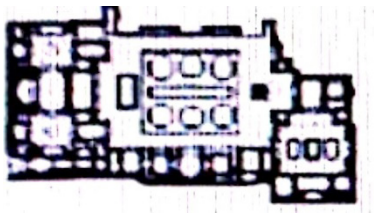
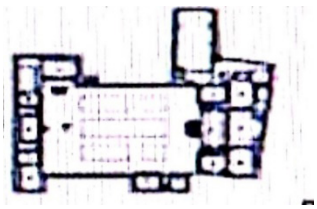
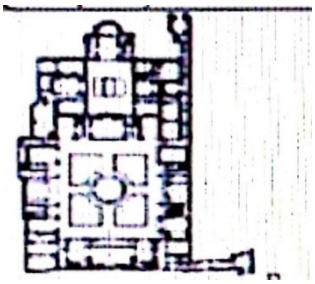
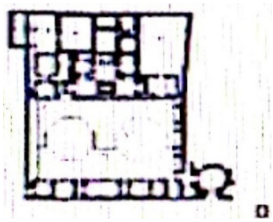
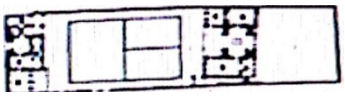
Houses of Esfahanak	Tabatabai House (Haj -Qasemi,1996)	Khextixch-House (Haj-Qasemi,1996)	Bakuchi House (Haj-Qasemi,1996)
			
	Likafzadeh House (Haj-Qasemi,1998)	Sheikh al-Islam House (Haj-Qasemi,1998)	Sukiaaian House (Haj- Qasemi, 1998)
			

Fig. 3: Analysis of Traditional Structure and Proposal for Implementing Advanced Construction Systems (Source: Bashieryan, 2021)

New building systems are generally based on non-traditional and industrial methods, involving a combination of materials and methods for design and construction (Douglas, 2006). As a result, they contrast with the specific forms of traditional construction. The term' industrialization of construction' is used to describe and encompass the concepts of modularization and prefabrication, which involve investment in equipment, facilities, and technology aimed at increasing output, reducing costs, and enhancing characteristics (Sebestyen, 2003), as well as craftsmanship and quality. The focus on mass production, standardization, specialization, appropriate organization, and convergence are essential conditions for the success of this process (Warszawski, 1999).

Today, industrial production of buildings involves employing organized methods for design, production planning, control, and mechanized production processes, utilizing technologies to replace skilled workers with machines. Such phenomena occur naturally in workshops, factories, or on-site, where machines are replaced by skilled labor. Industrialization includes the following:

Mass production. Products resulting from uniform operations for making identical products or utilizing automation: these products are produced within a certain scope without waste or loss, and they also exhibit diversity. For this purpose, the production tools are adapted according to the instructions received for each product (Sarja, 1998). The conventional construction methods and industrial construction are compared in Table 2.

Advantages of Adopting Industrial Construction Systems

A. **User:** Wider Application of the Product. Adaptability enables users to benefit from the same system under changing conditions, resulting in the replacement of multiple systems with a single one. However, the functions of adaptability must be easily applicable to the user. An adaptable system, throughout its lifespan, can be replaced by a large number of systems, leading to savings in capital, storage space, maintenance, and installation costs.

B. **Producer:** Wider Application of Design. Adaptability enables the producer to reuse existing design knowledge and industrial production infrastructure.

C. **Environment:** Reduced Total Production. Adaptability decreases the overall production and offers systems that are more efficient than conventional alternatives (Hashemian, 2019). Adaptability is especially advantageous when a system is phased out while still in good working condition. This premature phasing out can occur for the following reasons: (a) Changes in user needs or expectations. (b) Changes in operational conditions or government regulations, particularly increasing in modern engineering transactions. (c) Obsolescence of component technologies. In such cases, adaptability extends the product's lifespan.

MATERIALS AND METHOD

This research employs a mixed-methods approach, integrating various research methods tailored to different dimensions of the study to

Table 2: Differences Between Industrial Construction and Conventional Construction (Warszawski,1999, 8)

Industrial Construction	Conventional Construction
All activities are carried out in a permanent location	Activities are carried out at various temporary locations
Short to medium lifespan of a type of product	Long lifespan of a specialized product
A high degree of repetition and standardization	Low standardization: each project has distinct aspects
A limited number of simple tasks are required to produce a specific product	Many tasks require a high degree of manual skills necessary to complete a specific construction project
All tasks are performed at a fixed workstation	Each activity is carried out in a large workspace by workers moving .from one place to another
The workplace is precisely designed to meet human needs	Harsh and unfavorable working environment
In comparison, a stable workforce	Frequent changes in workers
Decision-making authority unit for design, production, and marketing	Decision-making authority among sponsors, designers, local government, contractors, and

achieve a more efficient process and more accurate results. Therefore, considering the nature of the research topic and the scope under review, it will encompass the following stages:

Philosophical Foundations and Perspectives. The present research embodies a positivist paradigm, focusing on the description and analysis of empirical data. This means that the principles and appropriate adaptive patterns in advanced housing construction design within historical contexts will be examined and assessed for their impact on factors such as cost reduction, increased speed, and aesthetic preferences among both the public and construction experts. However, there is still occasionally a negative impact on balancing speed and quality. (Parham & Halimi, 2021) .

Research Approach. The research is inductive, drawing conclusions from detailed information and establishing connections between them. Several advanced construction methods will be investigated concerning the principle of "adaptability" in design to clarify the conceptual impacts of the "adaptability" principle in design.

Research Strategy: The strategy is action research, where a selected sample is considered. This involves gathering information related to the issue, potential causes, and actions taken to resolve the problem, along with data analysis and the identification of solutions.

Research Methodology: The research employs a mixed-methods approach, incorporating both qualitative and quantitative methods. It aims to elucidate the principles of cost-effective design in dilapidated contexts and how these principles interact with qualitative variables while describing quantitative variables.

Time Frame: The study is cross-sectional, as the selected case study will be examined within a specific time frame.

Data Collection Tools: The tools for data collection in this research include observation, questionnaires, and archival documents. After conducting field observations to understand the architecture of housing in the historical context of a hot and dry climate, an analysis will be performed to validate the commonalities in the structures of architectural designs in such climates based on standardization. Subsequently, to gather residents' opinions and understand the components of their satisfaction regarding proposed housing designs compatible with advanced construction methods, a visual questionnaire will be employed. The rationale for selecting case studies from this historical context lies in their high tourism appeal and income potential for residents, alongside the favorable climatic conditions in this region. Various methods are utilized to reduce temperature, and the materials used are generally more cost-effective.

Current Time Frame: A questionnaire was developed and surveyed among residents and architectural experts to assess their satisfaction levels. The questionnaire has been divided into seven divisions, each containing 24 questions. Each question has been asked using a Likert scale, a rating scale used to measure survey participants' opinions, attitudes, motivations, and more. It uses a range of answer options, ranging from one extreme attitude to another, regarding their satisfaction through the variables. The statistical population of this research comprises the nine urban areas of the historical fabric of Yazd City, which, according to the 2021 census, houses 10,795 households in these historical areas. The basis for distributing the questionnaire will be household heads. According to Morgan's table, 384 household heads will be selected as samples from the nine urban areas. The sampling method is relative random sampling, meaning that samples will be randomly selected based on the number of households in each historical neighborhood. In conducting library studies, documents will be reviewed, and images and plans (including floor plans, elevations, and sections) of historical buildings in the hot and dry climate will be recorded. The typology of these plans will be analyzed in terms of modules and standardization. The study will also address advanced construction methods, including modeling and suggestions for using various advanced construction systems that consider factors such as speed, cost, and aesthetics. Advanced construction architecture should be presented as both rapid and economically beautiful while integrating brick facades and architectural patterns with the historical fabric of hot and dry climates. Subsequently, the application of these patterns will be evaluated in field surveys with the input of residents and experts.

Research Design. This research employs a mixed-methods approach, integrating both qualitative and quantitative elements. It is application-oriented, utilizing qualitative methods to interpret and analyze various books and articles related to adaptive construction. Quantitative methods (via questionnaires) will be used to analyze and evaluate adaptive buildings. The methods of data collection in this research are field-based. Initially, ten adaptive architectural approaches will be assessed, including: (1) Increased contrast and clarity of style; (2) Greater similarity and synergy between old and new styles; (3) Facade preservation; (4) Decorative facade design; (5) Compositional and dividing lines in design; (6) Neutral or zero-degree architecture; (7) Coexistence of unstable architecture; (8) Style and fantasy; (9) Creating inconspicuous or mirror-like buildings; (10) Contextual architecture with a continuity approach. The analysis and integration process of these approaches is based on the work of Amin al-Rahaya and Khodabakhshian (2021), which condensed the approaches into five categories: (1) Maximum contrast and clarity of style; (2) Maximum similarity and synergy between old and new styles; (3) Facade preservation; (4) Neutral or zero-degree architecture; (5) Creating new inconspicuous or mirror-like buildings. Based on these categories, a researcher-developed questionnaire was designed, which was distributed to participants in the current research. The data analysis will be conducted using SPSS software version 23.

RESULTS AND DISCUSSION

Based on the conducted interviews, factors influencing the optimal and appropriate development of prefabricated infill in housing construction within historical contexts were identified. These factors were then evaluated through a questionnaire to assess their impact level. In this section, respondents' opinions regarding each component and indicator are examined. The central indicators and distribution of influential factors in the optimal and appropriate development of prefabricated infill in historical housing construction are as follows (Table 3).

The Kolmogorov-Smirnov test was used to determine the type of statistical test required, as indicated in Table 4. The significance level (sig) of the Kolmogorov-Smirnov test for all research variables is greater than 0.05 (α). Therefore, all variables examined in the present

Table 3: Descriptive Statistics of the Research Variables

Variable	Observation	Minimum	Maximum	Skewness	Mean	Standard Deviation
Transportation System and the Formation of Road Networks	384	5	2	2.540	3.44	1.980
Coordination in Terms of Proportions, Visual Unity, and Construction Scale	384	5	2	2.876	3.45	1.340
Coherence in the Historical Fabric	384	5	2	1.800	3.22	1.891
Land Use Distribution	384	5	2	3.900	3.59	1.765
Speed	384	5	2	3.876	3.45	2.370
Cost	384	5	2	1.543	1.32	2.831
Beauty	384	5	2	3.432	3.49	1.321
Protection of Values	384	5	2	3.552	2.79	2.344

study have a normal distribution (Table 4).

Table 5 shows Cronbach's Alpha values for each variable, with all values exceeding the critical threshold of 0.7. This confirms a high level of internal consistency and reliability across the measured variables.

The mean obtained for establishing a correct relationship between the components of suitable housing design in historical contexts is 55.64, which is above the average level. Based on the one-sample t-test, since the significance level is found to be 0.000, it can be stated that this obtained value is statistically significant. Therefore, the research hypothesis is confirmed. Table 6 shows the result.

The mean obtained for the 'Compatible Conceptual Model' suitable for advanced architectural construction, encompassing components of speed, cost, and beauty in the design of suitable housing in historical contexts, is 59.55, within a numerical range of 1 to 7, which is above the average level. Based on the one-sample t-test, since the significance level is found to be 0.000, it can be concluded that this obtained value is statistically significant. Therefore, this research hypothesis is confirmed. Table 7 shows the details of the analysis.

The mean obtained for "the change in the quantitative and qualitative ratios of the 'compatible' presence of these components in advanced construction patterns in architecture among the middle-income housing suitable for the historical fabric leads to the destruction of architectural values" is 56.35, which is above the average. Based on the one-sample t-test, since the significance level is 0.000, it can be concluded that this obtained value is statistically significant. Thus, the research hypothesis is confirmed. Table 8 demonstrates the result.

The mean obtained for "the differences between the residents of historical fabrics and experts in using the ratios of the components of the 'compatible' design pattern in advanced architectural construction among the residential areas of historical fabrics" is 53.94, which is above the average. Based on the one-sample t-test, since the significance level is 0.000, it can be concluded that this obtained value is statistically significant. Thus, the research hypothesis is confirmed. Table 9 indicates the details of the analysis.

Table 4: Examination of the Normality of the Distribution of Research Variables

Variable	Observation	Mini-mum	Maxi-mum	Skewness	Mean	Standard Deviation
Variable		Number	Test Statistic	Significance Level (Sig.)		Result
Transportation System and the Formation of Road Net-works		384	0,76	0,067		It follows a normal distribution
Coordination in Terms of Proportions, Visual Unity, and Construction Scale		384	0,77	0,092		It follows a normal distribution
Coherence in the Historical Fabric		384	0,89	0,103		It follows a normal distribution
Land Use Distribution		384	0,75	0,078		It follows a normal distribution
Speed		384	0,76	0,120		It follows a normal distribution
Cost		384	0,88	0,089		It follows a normal distribution
Beauty		384	0,83	0,076		It follows a normal distribution
Protection of values		384	0,78	0,085		It follows a normal distribution

Table 5: Cronbach's Alpha

Variable	Test Statistic	Critical Region	Result
Transportation System and the Formation of Road Networks	0,87	0,7	Confirm
Coordination in Terms of Proportions, Visual Unity, and Construction Scale	0,82	0,7	Confirm
Coherence in the Historical Fabric	0,89	0,7	Confirm
Land Use Distribution	0,83	0,7	Confirm
Speed	0,88	0,7	Confirm
Cost	0,83	0,7	Confirm
Beauty	0,81	0,7	Confirm
Protection of values	0,93	0,7	Confirm

Table 6: One-Sample Student's t-Test

Significance Level	Degrees of Freedom	t value	Standard Deviation	Mean	Number
000.	461	115.256	16.93432	55.645	384

Table 7: One-Sample Student's T-Test

Significance Level	Degrees of Freedom	t value	Standard Deviation	Mean	Number
000.	461	96.721	17.78783	59.55	384

Table 8: One-Sample Student's T-Test

Significance Level	Degrees of Freedom	t value	Standard Deviation	Mean	Number
000.	461	115.256	13.13795	56.35	384

Table 9: One-Sample Student's T-Test

Significance Level	Degrees of Freedom	t value	Standard Deviation	Mean	Number
000.	461	96.721	15.60133	53.945	384

It is concluded that the protection of values has a positive influence on infill architecture. However, it should be noted that speed alone does not play a decisive role in infill architecture and may even have a negative impact when considered in isolation. Here, the impact of speed on infill architecture suggests that alongside cost and aesthetics, these structures should maintain a sufficient level of speed that aligns with this type of architecture. As discussed in the qualitative findings section, the following model (Fig. 4) was designed based on the dimensions and components identified by interviewees as influential factors for optimal and appropriate development of prefabricated infill in historical housing construction. In the quantitative section, this model was also validated through statistical tests, with the impact coefficients of each factor shown in the diagram (Fig. 5).

As indicated by the PLS output, we conclude that the circulation system and the formation of architectural networks have a t-value of 2.012. As shown in the t-value table, this number is greater than 1.96, and the path coefficient for this variable is 0.369. Thus, we find that the circulation system and the formation of architectural networks have a positive impact on intermediate architecture.

The coordination regarding visual unity settings and construction

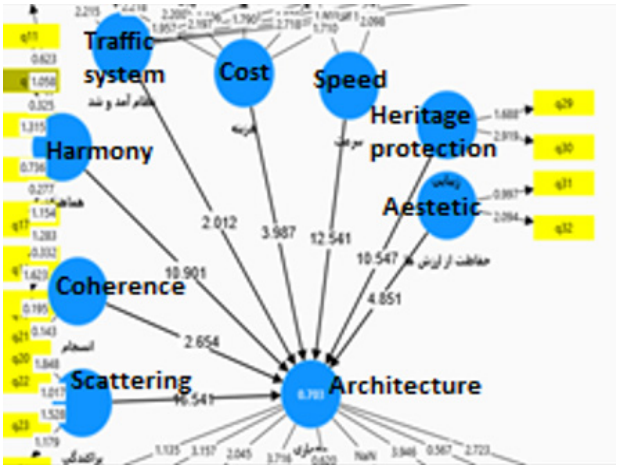


Fig. 4: T-Test Output of PLS Model Research

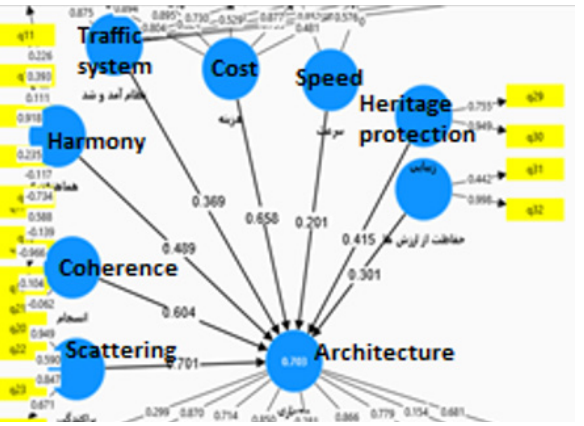


Fig. 5: Normality Test Output of PLS Model Research

scale has a t-value of 10.901, which, as indicated in the t-value table, is also greater than 1.96, with a path coefficient of 0.489. Therefore, we conclude that coordination in terms of visual unity settings and construction scale has a positive influence on intermediate architecture.

The historical coherence has a t-value of 2.654, which is greater than 1.96 according to the t-value table, and the path coefficient for this variable is 0.604. Thus, we find that historical coherence has a positive effect on intermediate architecture.

The dispersion of land uses has a t-value of 16.541, which is also greater than 1.96 according to the t-value table, with a path coefficient of 0.701. Therefore, we conclude that the dispersion of land uses has a positive influence on intermediate architecture.

The speed has a t-value of 12.541, and as shown in the t-value table, this number is greater than 1.96, with a path coefficient of 0.201. Thus, we conclude that speed has a positive effect on intermediate architecture.

The cost has a t-value of 3.981, which, according to the t-value table, is greater than 1.96, with a path coefficient of 0.658. Therefore, we conclude that cost has a positive influence on intermediate architecture.

The aesthetic aspect has a t-value of 10.547, which is greater than 1.96 according to the t-value table, and the path coefficient for this variable is 0.415. Thus, we conclude that aesthetics have a positive impact on intermediate architecture.

Finally, the preservation of values has a t-value of 4.851, which, as indicated in the t-value table, is greater than 1.96, with a path coefficient of 0.301. Therefore, we conclude that the preservation of values has a positive influence on intermediate architecture.

According to the conducted interviews, the factors influencing the optimal and appropriate development of prefabricated intermediate housing in the historical fabric include the circulation system and the formation of street networks, coordination in terms of proportions, visual unity, and construction scale, coherence in the historical fabric, dispersion of land uses, speed, cost, aesthetics, and preservation of values.

In the final stage, based on the designed questionnaire related to this topic and the statistical tests performed, these factors were categorized into three main categories: aesthetics, cost, and speed. The mean obtained for the speed factor was 3.45, for the cost factor was 3.32, and for the aesthetics factor was 3.49. Although the speed factor is positively more positive than the other factors, this factor

In advanced construction models, the components of speed, cost, and aesthetics, when balanced in compatible proportions, play a critical role in ensuring that architectural values are preserved in appropriate infill housing within historical contexts. Changes in the quantitative and qualitative balance of these compatible components in advanced construction models for infill housing in historical areas can lead to a loss of architectural values.

The subcategories of the three main components—speed, cost, and aesthetics—demonstrated significant numerical influence on the core phenomenon of this study. Naturally, omitting these components would alter the architectural value of a project (Fig.6).

CONCLUSION

Today, the process of intervening in historical fabrics that have deteriorated structurally or functionally, with the aim of their redevelopment, encompasses a wide range of dimensions that vary according to their unique characteristics, contexts, and existing limitations. A common theme emphasized in previous research is that intermediate development within these fabrics must guarantee the preservation of their original values. Consequently, most existing findings highlight that the new intermediate structures should harmonize with the historical context and neighboring buildings. However, this

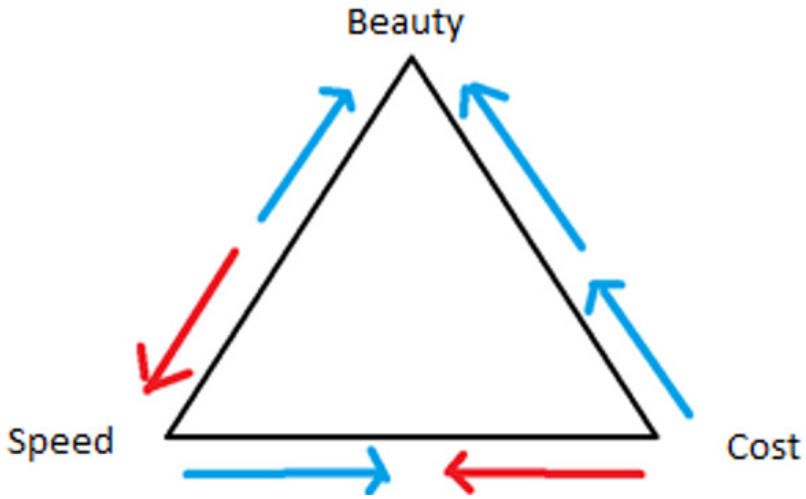


Fig. 6: Conceptual Model of Compatibility in Advanced Architectural Construction for Intermediate Housing in Historical Fabric, Representing the Relationships Among Speed, Cost, and Aesthetics in Design.

does not imply a mere imitation of past architecture; rather, the new construction should also reflect contemporary architecture.

Additionally, developing countries face a significant shortage of adequate housing. This issue is particularly acute in nations with ancient and valuable historical fabrics. In response, governments have sought various supply-based solutions to mitigate the growing housing deficit, leading to a trend toward prefabricated housing that offers faster construction and lower costs. Yet, this approach has resulted in an architecture lacking identity concerning the historical contexts of cities, which neither meets the desires of residents nor preserves the values of these valuable historical fabrics.

Based on existing studies and examples, it can be stated that to date, no model has been proposed that adequately addresses the issues of affordability and construction speed while also considering the aesthetics and structural integrity of intermediate buildings in harmony with their historical context. Occasionally, architects' designs for stability in buildings have suggested changes that jeopardize the architectural identity of intermediate structures within historical fabrics. In some cases, the authenticity of the architecture is so overlooked that the proposed models are rejected.

This dissertation aimed to present the most suitable type of housing construction that aligns with modern and advanced construction methods while also being cost-effective and time-efficient. It seeks to offer a model that harmonizes with the identity and authenticity of the architectural context of the historical fabrics in Iranian cities. Reports have repeatedly indicated that urban managers either neglect historical fabrics due to a lack of budget or remain in doubt about how to revitalize these areas. Ultimately, it is the impoverished residents of these historical fabrics who attempt to build their homes with limited budgets, which the country's cultural heritage experts do not approve.

The efforts made in the renewal and development of these areas face challenges; despite advancements in technology, changes in materials, gradual shifts in skills and craftsmanship, and evolving needs—both in form and content—none of the involved forces have seriously addressed these issues. If urban management has not incurred the appropriate costs in revitalizing the fabrics, its role in guiding public expenses and efforts has also been inconsistent over the decades. Historical fabrics are typically the result of a gradual transformation process spanning over a thousand years, reflecting the historical accumulation and manifestation of the cultural, social, and economic systems of their respective communities.

The primary issue is that the structural changes—whether in the old or new sections of the city—do not logically continue from their historical roots. In other words, the principles of past architecture and urbanism have been forgotten. Tavassoli (1989) lamented the "continuation of life in the old fabrics of cities" at a seminar regarding the numerous ruins in the historical fabric of Yazd, stating that residents of historical fabrics have never been presented with a model of what to do or how to build. If, at that time, the negligence of urban management institutions was highlighted, and warnings were issued about the need for educational models for residents in historical fabrics regarding the renovation of dilapidated units, today, after more than a quarter of a century, we must think of revitalization not merely in terms of dilapidated units but in terms of broader historical fabric areas.

In conclusion, Parsi et al. (2023) have implemented innovative methods for preserving and revitalizing the historical fabric of Esfahak in South Khorasan and other similar regions, demonstrating the potential for a harmonious approach to modern construction that

respects historical context. By integrating advanced construction methods with a deep understanding of historical authenticity, we can foster sustainable development in these invaluable urban landscapes.

ACKNOWLEDGMENT

This article is taken from the Ph.D. thesis of the first author with the title "Expounding The Prefabricated Infill Model In Housing Development Within Historical Urban Fabrics"conducted under the supervision of the second author, Dr. Ahmad Mirzkouchak Khoshnovis (first supervisor); the third author, Dr. Hale Hosseinpour (second supervisor); and the fourth author, who serves as the consultant professor at the Islamic Azad University, Pardis Branch.

AUTHOR'S CONTRIBUTIONS

The corresponding author of this article is Tayebeh Heydari. Additionally, Dr. Ahmad Mirzakuochak Khoshnevis, Haleh Hosseinpour, and Hadiseh Kamran Kasmaei have contributed to various sections of this research.

CONFLICT OF INTERESt

The authors fully adhere to publishing ethics and have avoided any form of plagiarism, misconduct, data fabrication, or dual submission and publication. There are no commercial interests associated with this research, and the authors have not received any financial compensation for presenting their work.

REFERENCES

Abouie, R., & Jafari, N. (2015). Critique of the status of infill buildings in historical sites from the perspective of international

Amin al-Rahaya, I., & Khodabakhshian, M. (2021). Assessment of residents' opinions on utilizing infill development approaches, Architectural Thought, 3(6), 160-174. doi: 10.30479/at.2019.11383.1299.

Bamanyan, M. R (2002). An Introduction to the Role and Application of Scale in Iranian Architecture, Modares Art Journal, Issue 1.

Bashieryan, A. (2021), Designing the Esfahak cultural complex with a seismic safety approach and creating a sense of belonging in the residents, Danesh. Degree students in architecture, Qazvin Islamic Azad University). Gohar Danesh Publications, 25(68), 119-138. SID. https://sid.ir/paper/514302/fa

Elham, A & Meghdady, |Kh, (2022), Evaluation Residents Think about the Use of Infill Development Approaches (Case Study: New Buildings Jouybara of Isfahan), Journal: HOVIATESHAHR Year: | Volume:15 | Issue:48 Page(s): 93-106

Ghaderian, M. (2017). Framework for infill development in historical contexts: A case study of the Ilchi Khan site design agenda

Ghadiri, B. (2006). New structures in historical environments. Cultural Research Bureau, Tehran.

Ghareh Beyglou, M., Ahadnejad Ebrahimi, A., & Ilgar Ardebili, E. (2019). Infill architecture: An interdisciplinary approach to

Ghazanfariyan, S. R. N., & Ziabakhsh, N. (2021). Measuring the impact of infill architectural criteria on the design of cultural

Haji Ghasemi, K. & Mousavi Rozati, M. D. & Soltanzadeh, H. (1996). [Treasury of Culture of Islamic Architectural Works of Iran, First Volume: Kashan Houses]. (Pp. 5, 35, 36, 37, 40, 42, 47, 48, and 50). Tehran: Shahid Beheshti University. ISBN: 9789644572685.

Haji Ghasemi, K. & Mousavi Rozati, M. D. & Tahbaz, M. (1998). [Treasury of Culture of Islamic Architectural Works of Iran, Fourth Volume: Isfahan Houses]. (Pp. 5, 22, 23, 24, 26, 27, 65, 66, 67, 68, and 69). Tehran: Cultural Heritage Organization of the Country. ISBN: 9646027296.

Hashemian, S. Z. (2019). A review of global experiences in infill development in architecture (Collection of articles by Master's House Designs from the Perspective of Passive Cooling (Case Study: Qajar Houses of Shiraz)." Scientific Journal of in the historical fabric of Yazd. Journal of Architecture and Urbanism, 9 (19), 93-112. SID. https://sid.ir/paper/215864/fa international declarations and charters. Urban and Regional Studies and Research, 6 (22), Autumn. Journal of Architecture and Urbanism, 10(20), 69-84. https://sid.ir/paper/215817/fa

Masoud, M. H. R., & Beygzadeh Shahraki, M. (2014). Foundations of infill building formation in historical contexts based on

Noriyan, F., Abdollahpour Raskani, A., Sajad, S., & Ghazi, R. (2018). Prioritizing infill development strategies in cross-sectional

Olovizadeh, S. E., Islami, S. G., & Habib, F. (2018). Explanation of the quasi-fractal model in the context-based structure of

Parham, M., & Halimi, F. (2021). Examination of architectural components and decorations in middle-period houses of Shiraz. In

Parsi, F., Heydari, A. A., & Kiai, M. (2023). Comparative analysis of housing pattern language at the intermediate scale (micro-

Pesaran, A., Karimi Nia, Shahab, Nazemi, Elham, & Toghiani, Shirin. (2019). "Redefining the Role of Scale in Traditional

Pirnia, M. K., & Mahranian, G. H. (2019). Familiarization with Islamic architecture of Iran: Urban and rural buildings. Soroush Proceedings of the 7th International Annual Congress on Civil Engineering, Architecture, and Urban Development (UR). https://civilica.com/doc/1373951/

Razeghi, A., & Hoorandi, B. (2018). Analyzing architectural heritage revitalization experiences based on measuring user satisfaction: A case study of revitalization experiences with residential-tourism use in the historical context of Yazd. Scientific Journal, 16 (76), 57-68. https://doi.org/10.22034/bagh.2019.142666.3713

Sarja, A., (1998), OPEN AND INDUStRIALISED BUILDING, Espoo, Finland International Council for Building Research Studies and Documentation E & FN Spon An imprint of Routledge London and New York

Shahteymouri, Y., & Mazaheriyan, H. (2012). Design Guidelines for New Structures in Historic Contexts. Architecture an

space) (Case study: Examination of tripartite divisions in the houses of Yazd and Tabriz). Journal of Architecture and spaces. City Identity, 15 (45), Spring.

Tavassoli, M. (1989). Urban design in the historic fabric of Yazd. Center for Urban Studies and Architecture Research of Iran. The

design of historic contexts (Case study: Mashruteh Complex in the historic bazaar of Tabriz, Iran). Bagh Negar, traditional Iranian bazaars. *Islamic Art Studies, 14*(29), 28-58. https://sid.ir/paper/136751/fa, urban areas (Case study: Region 6 of Mashhad).

Warszawski, A., (1999). Industrialized and Automated Building Systems: A Managerial Approach.

Zabetiyan, E., and Khairaldin, R., (2016). "Examining Practical Experiences in the Field of Thermal Comfort Perception in Urban Open Spaces." Urban Management Journal, Issue 43, Pages 77-96.

Zakari, M. H., Ghahramani, A., & Shahnaazi, D. (2016). Module and Iranian Golden Rectangle Theory in Historical Houses of